CLAIMS

What is claimed is:

1. A method for processing an electromagnetic wave comprising the steps of:

receiving rectangular coordinate information for said electromagnetic wave; and

directly converting said rectangular coordinate information into a magnitude signal, a sin(Φ), and a cos(Φ) signal using a CORDIC algorithm, where Φ represents a phase of said electromagnetic wave.

2. A method as in claim 1, wherein said step of direct converting is accomplished using shift and add/subtract operations and a look-up table.

3. A method as in claim 2, wherein said shift and add/subtract operations are accomplished using a processor employing said CORDIC algorithm.

4. A method as in claim 2, wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix}$$ and

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, Z_0 is set to 0, and μ(n) is the sign of the electromagnetic wave;

wherein Y_N goes to zero, X_N equals said magnitude signal, and Z_N represents said phase of said electromagnetic wave; and

wherein Z_N is passed through said look-up table to determine said sin(Φ) and said cos(Φ) signals.

5. A method as in claim 1, wherein said step of direct converting is accomplished using at least two cascaded processors employing said CORDIC algorithm.

6. A method as in claim 5, wherein at least one of said processors is programmed to determine said sin(Φ) signal and said cos(Φ) signal in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to a constant gain value, Y_0 is set to 0, Z_0 is set to the value of said phase of said electromagnetic wave determined in a previous processor, and μ(n) is equal to the sign of the phase of said electromagnetic wave; and

wherein X_N is equal to cos (Φ) and Y_N is equal to sin (Φ).

7. A method as in claim 1, wherein said step of direct converting is accomplished using shift and add/subtract operations only.

8. A method as in claim 7, wherein said step of direct converting includes a preprocessing stage that maps said rectangular coordinate information to a right hand plane of a coordinate map to avoid any phase ambiguity prior to said shift and add/subtract operations.

9. A method as in claim 8, wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix}$$

and

$$\begin{bmatrix} C_{n+1} \\ S_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & -\mu(n)2^{-n} \\ \mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} C_n \\ S_n \end{bmatrix}$$

where the number of iterations, n, varies from 0 to $N - 1$;

wherein X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, C_0 is set to a constant gain value K, S_0 is set to 0, and $\mu(n)$ is the sign of the electromagnetic wave and wherein said magnitude equals X_N multiplied by said constant value K and Y_N equals 0;

wherein X_0 is then set to said constant value K and Y_0 is set to 0; and

wherein said cos(Φ) equals X_N multiplied by the sign of said in-phase component value and sin(Φ) equals Y_N multiplied by the sign of said quadrature component value.

10. An electromagnetic wave processor programmed to receive rectangular coordinate information for an electromagnetic wave, and to directly convert said rectangular coordinate information into a magnitude signal, a sin(Φ), and a cos(Φ) signal using a CORDIC algorithm, where Φ represents a phase of said input signal.

11. A processor as in claim 10, wherein said step of direct converting is accomplished using shift and add/subtract operations.

12. A processor as in claim 11, wherein said processor is programmed to map said rectangular coordinate information to a right hand plane of a coordinate map to avoid any phase ambiguity prior to said shift and add/subtract operations.

13. A processor as in claim 10, wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$\begin{bmatrix} C_{n+1} \\ S_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & -\mu(n)2^{-n} \\ \mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} C_n \\ S_n \end{bmatrix}$$

where the number of iterations, n, varies from 0 to $N - 1$;

wherein X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, C_0 is set to a constant gain value K, S_0 is set to 0, and μ(n) is the sign of the electromagnetic wave and wherein said magnitude equals X_N multiplied by said constant value K and Y_N equals 0;

wherein X_0 is then set to said constant value K and Y_0 is set to 0; and

wherein said cos(Φ) equals X_N multiplied by the sign of said in-phase component value and sin(Φ) equals Y_N multiplied by the sign of said quadrature component value.

14. A processor as in claim 10, further comprising a look-up table;

wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, Z_0 is set to 0, and μ(n) is the sign of the electromagnetic wave;

wherein Y_N goes to zero, X_N equals said magnitude signal, and Z_N represents said phase of said electromagnetic wave; and

wherein Z_N is passed through said look-up table to determine said sin(Φ) and said cos(Φ) signals.

15. A processor as in claim 10, further comprising at least one additional processor employing a CORDIC algorithm;

wherein said at least one additional processor is programmed to determine said sin(Φ) signal and said cos(Φ) signal in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to a constant gain value, Y_0 is set to 0, Z_0 is set to the value of said phase of said electromagnetic wave determined in said

electromagnetic wave processor, and $\mu(n)$ is equal to the sign of the phase of said electromagnetic wave; and

wherein X_N is equal to cos (Φ) and Y_N is equal to sin (Φ).

16. A method for processing of an input wave comprising the steps of:

receiving quadrature information that represents said input wave when combined;

using a CORDIC algorithm to directly convert said quadrature information into a magnitude signal, a sin(Φ), and a cos(Φ) signal, where Φ represents a phase of said input signal;

generating at least one modified signal using at least one of said sin(Φ) signal and/or said cos(Φ) signal; and

regulating said modified signal using said magnitude signal to generate an output signal.

17. A method as in claim 16, wherein said step of direct converting is accomplished using shift and add/subtract operations and a look-up table.

18. A method as in claim 16, wherein said step of direct converting is accomplished using at least two cascaded processors employing a CORDIC algorithm.

19. A method as in claim 16, wherein said step of direct converting is accomplished using shift and add/subtract operations only.

20 A method as in claim 19, wherein said step of direct converting includes a preprocessing stage that maps said rectangular coordinate information to a right hand plane of a coordinate map to avoid any phase ambiguity prior to said shift and add/subtract operations.

21. A method as in claim 16, wherein said step of regulating said modified signal is performed using a plurality of segments.

22. A method as in claim 21, wherein one or more of said segments is independently controlled as a power amplifier to contribute power to an output signal.

23. A method as in claim 22, wherein said power is contributed to said output signal by using one or more selected from the group consisting of power transformers, quarter-wave transmission lines, discrete LC components, and a Pi-networks.

24. A method as in claim 21, wherein one or more of said segments is independently controlled as a current source to contribute current to an output signal.

25. An apparatus for processing of an input wave comprising the steps of:

a processor programmed for receiving quadrature information that represents said input wave when combined, and for using a CORDIC algorithm to directly convert said quadrature information into a magnitude signal, a $\sin(\Phi)$, and a $\cos(\Phi)$ signal, where Φ represents a phase of said input signal;

a signal generator for generating at least one modified signal using at least one of said sin(Φ) signal and/or said cos(Φ) signal; and

an output signal generator for receiving said modified signal and using said magnitude signal to generate an output signal.

26. An apparatus as in claim 25, wherein said direct converting is accomplished using shift and add/subtract operations.

27. An apparatus as in claim 26, wherein said processor is programmed to map said rectangular coordinate information to a right hand plane of a coordinate map to avoid any phase ambiguity prior to said shift and add/subtract operations.

28. An apparatus as in claim 25, wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$\begin{bmatrix} C_{n+1} \\ S_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & -\mu(n)2^{-n} \\ \mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} C_n \\ S_n \end{bmatrix}$$

where the number of iterations, n, varies from 0 to N – 1;

wherein X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, C_0 is set to a constant gain value K, S_0 is set to 0, and μ(n) is the sign of the electromagnetic wave and wherein said magnitude equals X_N multiplied by said constant value K and Y_N equals 0;

wherein X_0 is then set to said constant value K and Y_0 is set to 0; and

wherein said cos(Φ) equals X_N multiplied by the sign of said in-phase component value and sin(Φ) equals Y_N multiplied by the sign of said quadrature component value.

29. An apparatus as in claim 25, further comprising a look-up table;

wherein said magnitude signal, said sin(Φ) signal and said cos(Φ) signal are generated in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix} \quad \text{and}$$

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to an in-phase component value of said electromagnetic wave, Y_0 is set to a quadrature component value of said electromagnetic wave, Z_0 is set to 0, and $\mu(n)$ is the sign of the electromagnetic wave;

wherein Y_N goes to zero, X_N equals said magnitude signal, and Z_N represents said phase of said electromagnetic wave; and

wherein Z_N is passed through said look-up table to determine said sin(Φ) and said cos(Φ) signals.

30. An apparatus as in claim 25, further comprising at least one additional processor employing a CORDIC algorithm;

wherein said at least one additional processor is programmed to determine said sin(Φ) signal and said cos(Φ) signal in accordance with the equations:

$$\begin{bmatrix} X_{n+1} \\ Y_{n+1} \end{bmatrix} = \begin{bmatrix} 1 & \mu(n)2^{-n} \\ -\mu(n)2^{-n} & 1 \end{bmatrix} \begin{bmatrix} X_n \\ Y_n \end{bmatrix}$$ and

$$Z_{n+1} = Z_n + \mu(n)\arctan(\frac{1}{2^n})$$

where the number of iterations, n, varies from 0 to N – 1, X_0 is set to a constant gain value, Y_0 is set to 0, Z_0 is set to the value of said phase of said electromagnetic wave determined in said electromagnetic wave processor, and μ(n) is equal to the sign of the phase of said electromagnetic wave; and

wherein X_N is equal to cos (Φ) and Y_N is equal to sin (Φ).

31. An apparatus as in claim 25, wherein said output signal generator comprises plurality of segments.

32. An apparatus as in claim 31, wherein one or more of said segments is independently controlled as a power amplifier to contribute power to an output signal.

33. An apparatus as in claim 32, wherein said power is contributed to said output signal by using one or more selected from the group consisting of power transformers, quarter-wave transmission lines, discrete LC components, and a Pi-networks.

34. An apparatus as in claim 31, wherein one or more of said segments is independently controlled as a current source to contribute current to an output signal.